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ABSTRACT

An instrument was constructed to measure changes in teacher attitudes and beliefs resulting from training in the teaching of the Elementary Science Study (ESS) program. The 40-item, Likert type instrument was administered to a group of 22 elementary teachers attending a three-week National Science Foundation summer institute, on the first morning of their attendance and again on the last afternoon. Analyses of the data revealed that no items showed significant change in the non-preferred direction and that the means of 21 of the 40 items had changed significantly in the preferred direction. Of those items showing no significant change, most were high on the pretest. Analysis by subject revealed that 14 subjects showed significant change in the preferred direction, one showed significant change in the unpreferred direction, and seven subjects showed no significant change. The instrument developed is included in the document. (CS)

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DEVELOPMENT OF AN INSTRUMENT TO MEASURE BELIEFS ABOUT TEACHING SCIENCE

A Paper Presented at
The Fiftieth Annual Convention of the
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DEVELOPMENT OF AN INSTRUMENT TO MEASURE BELIEFS ABOUT TEACHING SCIENCE

Evaluation of teacher education presents many problems, especially in programs whose philosophies demand radical restructuring of teacher behavior. Direct observation of teacher behavior change, although desirable, is expensive and difficult. Often, the only practical means of assessment is the use of some instrument that can be applied economically during the physical presence of teachers at the training site.

While many studies have been reported in which change in general beliefs or attitudes was a parameter, investigators sometimes find that pre-existing instruments are not sufficiently sensitive to the specific goals of the training program to be studied. For this reason, Good (1971) developed a beliefs instrument to assess the particular program with which he was involved. The utility of Good's instrument for assessing other programs has been reported (Strawitz, 1975, 1976). This author also used Good's instrument in connection with an inservice extension course on the Elementary Science Study (ESS) program. While the overall results were promising, the number of individual items showing significant positive change was not as high as that reported by Good. It seemed likely that much of this disparity could be accounted for by the differences between the goals of the program for which Good's instrument was developed and the goals of the program assessed by the present author. This thought led to the development of the Beliefs About Science Teaching (BAST) instrument, which was based on the specific goals of an NSF Summer Institute for inservice training in the ESS program.

PHILOSOPHY OF THE ESS PROGRAM

The philosophy which underlies the ESS program may be characterized as quite different from that apparently forming the basis of common practice in elementary schools. It requires a conceptualization of the teacher's role which is often in direct conflict with the perceived role implicit in traditional teaching. Rogers and Voelker (1970) describe the role aspect of the ESS program:

> To teach ESS materials as intended demands a certain view of teaching, of the learner, and of the learning process. The teacher's role in an ESS classroom is one of consultant, guide, and catalyst. ...For this reason, the teacher must see the child as having an extraordinary capacity for learning and believe that he learns best from his own activity. ...(Those) who do not share (this view) might be persuaded to reconceive their role as teachers through sensitivity training, workshops, and reading.

The program developers (ESS Reader, 1970) feel that because children are developmentally immature, they must work out ideas from concrete experience with materials. They must have a great deal of freedom to do their own structuring of the experience. The cognitive gains derived come from the child himself as he strives to understand and control the materials. When such understanding and control is attained, it is accompanied by positive affect toward self, science, and learning. Because there is no general consensus on particular facts, concepts, or principles of science that should be required at the elementary school level, ESS takes the view that the development of logical thought processes and the concomitant positive affect should be the goals of an effective science program. Implicit in

these ideas is the belief that the physical world is accessible to discovery and understanding, not just by authorities, but by anyone who can observe and reason.

DESCRIPTION OF THE ESS INSTITUTE

The institute was held in suburban Los Angeles County during July of 1975. It lasted for three weeks and involved twenty-two inservice teachers. The staff consisted of three instructors and a materials preparation person. Several consultants contributed additional input and technical assistance. The activities were mainly of three types: working as learners with science materials, teaching and analyzing mini-lessons done with children, and affective exercises intended to develop insight into the role of the teacher. Homework readings were assigned from Mary Budd Rowe's Teaching Science as Continuous Inquiry (1973). Rowe's ideas about fate control and wait time (1974 a, b,) were applied during many of the activities. For example, each participant analyzed videotapes of her/his mini-lessons for wait time. The teaching-taping-analyzing activities began in the second week, and may have been an especially strong factor in the restructuring of attitudes and beliefs. During the first week, when activities consisted mainly of work with science materials, the participants were relaxed and generally positive in attitude. They were having a good time. When the teaching-taping-analyzing activities began, an element of tension, perhaps even dissonance, was apparent. By the third week, most of the participants had seemingly resolved their tensions, and an atmosphere of accomplishment prevailed.

ITEM CONSTRUCTION AND ADMINISTRATION

Based on the described philosophy, eight categories were extracted, from which forty Likert statements were devised:

1. Who structures the activities
2. Authority vs. self as the source of science knowledge
3. Importance of working directly with materials
4. Value and interest of science for children
5. Evaluation of teaching and learning
6. Verbal interactions
7. Nature of science
8. Required content of elementary school science

The categories were used only as stimuli for generating test items. No attempt was made to develop independently interpretable subscales. It was attempted to word the statements in a manner which would allow detection of subtle pre-post changes, rather than only marked changes in belief. The idea was to include statements to which teachers might change in their reaction, for example, from "strongly disagree" to "undecided." This could be interpreted as becoming more open to the idea expressed by the item. In other words, although there was a preferred direction of change for each item, it should not be construed that maximum congruence with ESS goals requires a maximum agreement (or disagreement, depending on the direction) with each statement.

The first draft of the instrument was administered to the other two institute instructors. Items rated on the unpreferred side of the scale and those regarded as ambiguous were revised. A copy of the version administered at the institute is included at the end of the paper.

The instrument was administered to the institute participants on the first morning before any instructional activities took place, and again on the last afternoon, three weeks later. To assure anonymity, a system of secret identification numbers was used. A numbered sheet was circulated and the participants signed their names next to any number they wished. This became each person's identification number to enter on the response sheet. A volunteer participant held the list and brought it back on the final day so that each person could be reminded of her/his number to enter on the post-test response sheet. A great display was then made of destroying the number sheet. At no time did anyone other than the participants have access to the sheet. This system preserved anonymity while permitting each subject's pre and post-tests to be matched, thus avoiding possible mortality problems and allowing analysis by subject as well as by item.

RESULTS

Split-halves reliability calculated on the pretest data was 0.86. Content validity is claimed on the basis of item construction based on training objectives and expert ratings. Pre-post compari-

sons of total scores using the t-test for related measures showed a change in the preferred directions which was significant at the 0.001 level. Criterion validity, the extent to which trained subjects score higher than untrained subjects, is supported by this result.

The t-test on items showed that the means of 20 of the 40 items had changed significantly (0.05 level or better) in the preferred direction. No items showed significant change in the unpreferred direction. Of those items showing no significant change, most were high on the pretest, suggesting that subjects held the congruent beliefs on those items before the institute began. When the data were analyzed by subjects, 14 subjects (63.6%) showed significant change in the preferred direction, one subject (4.5%) showed significant change in the unpreferred direction, and seven subjects (31.8%) showed no significant change.

CONCLUSIONS

This instrument, the BAST, appears to have considerable promise in evaluating ESS teacher training programs, even though much work remains to be done. An important next step would be to study the relationship of measures with the BAST to subsequent directly observed teacher behavior. If such relationship could be established, it would support predictive validity, and greatly enhance the credibility and utility of the instrument.

Since 1975, NSF institutes have been in short supply, making it impossible to test comparable groups. Several preservice methods

classes in which the ESS philosophy formed the strongest element, have been assessed, however. As might be expected for several reasons, the number of items reaching significance was less than for the ESS institute group. Total pre-post change was significant in the preferred direction for every group, however. Item analysis on the data from all sources and feedback from subjects subsequent to post-testing have formed a basis for a second version of the EAST. This second version is now being used with two comparable methods classes, one that involves ESS ideas and one that does not.

The author wishes to gratefully acknowledge her debt to Ronald Good, whose original instrument provided the impetus for this study, as well as several items used in the EAST.

TABLE I

T-TEST FOR RELATED MEASURES ON PRE-POST CHANGE BY ITEMS

Item No.	Preferred Direction*	t	p<**	Item No.	Preferred Direction*	t	p<
1.	A	1.317	NS	21.	D	3.461	.01
2.	D	1.804	NS	22.	A	1.225	NS
3.	D	3.637	.01	23.	D	4.814	.001
4.	D	0	NS	24.	D	0.718	NS
5.	D	-1.703	NS	25.	A	0	NS
6.	A	2.109	.05	26.	D	2.794	.02
7.	D	12.090	.001	27.	D	1.074	NS
8.	A	-1.571	NS	28.	D	0	NS
9.	D	2.246	.05	29.	D	1.232	NS
10.	D	-0.710	NS	30.	A	0.644	NS
11.	D	0.891	NS	31.	D	2.534	.02
12.	A	0.699	NS	32.	D	4.092	.001
13.	D	9.176	.00.	33.	D	4.414	.001
14.	A	2.308	.05	34.	D	1.450	NS
15.	A	-1.225	NS	35.	D	9.925	.001
16.	D	2.451	.05	36.	A	4.284	.001
17.	A	2.630	.02	37.	D	2.326	.05
18.	A	2.217	.05	38.	A	1.577	NS
19.	D	0	NS	39.	D	2.246	.05
20.	A	0.419	NS	40.	D	2.235	.05

* A = toward "strongly agree." D = toward "strongly disagree."

**p (for two-tailed test)

REFERENCES

ESS Reader, Newton, Mass.: Elementary Science Study, 1970.

Good, Ronald G., "A Study of the Effects of a 'Student-Structured' Laboratory Approach to Elementary Science Education Methods Courses: Affective Domain," Journal of Research in Science Teaching 8(3) 255-262, 1971.

Rogers, Robert E. and Alan M. Voelker, "Programs for Improving Science Instruction in the Elementary School: Part I, ESS," Science and Children 7(5) 35-43, 1970.

Rowe, Mary Budd, Teaching Science as Continuous Inquiry, New York: McGraw-Hill, 1973.

Rowe, Mary Budd, "Wait-Time and Rewards as Instructional Variables, Their Influence on Language, Logic, and Fate Control: Part I--Wait-Time," Journal of Research in Science Teaching 11(2) 81-94, 1974 (a).

Rowe, Mary Budd, "Relation of Wait-Time and Rewards to the Development of Language, Logic, and Fate Control: Part II--Rewards," Journal of Research in Science Teaching 11(4) 291-308, 1974 (b).

Strawitz, Barbara M., "Dogmatism and the Beliefs of Preservice and Inservice Elementary Science Teachers," paper presented at the National Association for Research in Science Teaching Annual Convention, Los Angeles, 1975.

Strawitz, Barbara M., "The Effects of an Activity-Centered Elementary Education Science Methods Course on the Attitudes of Preservice Teachers," paper presented at the National Association for Research in Science Teaching Annual Convention, San Francisco, 1976.

BELIEFS ABOUT SCIENCE TEACHING, VERSION 1

1. A teacher can adequately evaluate children's progress in science through informal observation during activities with materials.

2. Demonstrations of scientific principles to a class by a teacher are highly important to children.

3. To see if their experiments came out correctly, children should be encouraged to do library research.

4. Most children who cannot read at their grade level would not be interested in science.

5. Since society is basically competitive in nature, the use of letter grades should be used in science to be fair to the children in helping them prepare for the future.

6. Elementary school science should focus on children's work with concrete objects and materials.

7. The teacher should positively reinforce those children who are doing valuable things with their science materials in order to indirectly influence other children toward those goals.

8. Questioning authority is one of the important values of science.

9. There are some things in elementary school science that have to be learned whether they are interesting or not.

10. It is not realistic to expect as much in science from children who are poor readers as from those who are good readers.

11. The teacher should impress on the children how to behave when working with messy materials so that spills are avoided.

12. Children who want to do some simple procedure over and over again in science should be allowed to do it.

13. Long pauses between teacher questions and pupil responses tend to cause anxiety in children.

14. Science topics such as atoms and molecules, dinosaurs, or the solar system are less valuable in elementary school than topics such as behavior of liquids, electricity, or worms.

15. It is as important for children to ask questions in science as it is for them to give answers.

16. When children work with science materials, they generally need some guidance in order to achieve significant learning.

17. In elementary school science, it is more important for children to develop logical thinking abilities than to learn any specific scientific facts or concepts.

18. The teacher should not suggest to a child that he has given a wrong answer as a result of working with materials during a science activity.

19. Compared to reading and math, science is of little practical importance in a child's life.

20. The first goal of teaching is to encourage enjoyment.

21. There are certain facts and concepts in science that should be learned by children while they are in elementary school.

22. Science is basically an attempt to make sense out of the patterns and relationships in nature.

23. It is a good practice to introduce the new science vocabulary words children will need before their activities with materials.

24. The place of the experiment in elementary school science is to verify previously learned concepts.

25. Error should be accepted as a natural part of the learning process.

26. The teacher should be fairly specific in giving directions at the beginning of a science activity to avoid frustrating the children.

27. Messing around with science materials, even when not disruptive, should be discouraged because it is not a constructive use of time.

28. Science is more important for children who will go to college than for those who will not.

29. Allowing children to do what they want when working with science materials would result in many discipline problems.

30. The technique of summarizing what children have learned after science activities through group discussions has little value in helping to understand science and may even have detrimental effects.

31. Some children need to be reminded not to get sidetracked during a science activity to keep them from falling behind.

32. A child who is doing well in science should be able to talk fluently about the activities, using proper scientific terminology.

33. An important advantage in having a good science background for a teacher is in being able to answer children's questions.

34. In order to understand what science is all about, a child can gain about as much from teacher demonstrations, reading, and discussion as from working with materials.

35. To learn science is to learn the concepts and principles that have been identified by scientists.

36. A teacher who usually answers children's questions of fact or explanation in science is probably doing them a disservice.

37. Activities with science materials should be used as a reward for children who work well in their science textbooks.

38. Common objects are better for children's science activities than specialized equipment because they link science to everyday life in the child's mind.

39. Written tests are necessary in science to find out if children have learned the concepts and principles studied in class.

40. The teacher must sometimes intervene to prevent children from drawing incorrect conclusions from their science activities.